इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 13361 (1992): Textile Dyestuffs - Identification of application classes of dyestuffs in substance [TXD 7: Textile Sizing and Finishing Materials]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

IS 13361 : 1992

(Reaffirmed 2000)

भारतीय मानक

वस्त्र रंजन सामग्री – यथारूप वस्त्र रंजन सामग्रियों के अनुप्रयोग वर्ग ज्ञात करने की पद्धति

Indian Standard

TEXTILE DYESTUFFS – IDENTIFICATION OF APPLICATION CLASSES OF DYESTUFFS IN SUBSTANCE

UDC 677·047·42

© BIS 1992

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 1992 **Price Group 4**

Dyestuffs Sectional Committee, TX 17

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Dyestuffs Sectional Committee had been approved by the Textile Division Council.

With the continuous progress in the synthetic dyestuff industry and the rapid increase in the number of dyestuffs in use, the existence of reliable methods of their identification needs no emphasis. Such methods enable the dyer, calico printer, dyestuff manufacturer and other users of the dyestuff to ascertain whether certain products supplied by one firm are or are not identical with the products sold under a different brand name by another firm. Mere similarity in shade and corresponding methods of application do not suffice alone to establish equivalence. It is equally important to know that the competing dyestuffs are chemically identical, or at least, they belong to the same chemical class, because the degree of fastness and other important properties of the dyestuff depend upon its chemical constitution and determine its suitability for the purpose in view.

According to the scheme of identification of dyestuffs given in this standard, the various dyestuffs have been classified into two main groups, viz (a) water soluble dyestuffs, and (b) water insoluble dyestuffs. The further classification of the dyestuffs in each group has been prescribed based on their behaviour upon reduction, re-oxidation and other chemical properties. Some additional tests have also been prescribed for certain dyestuffs.

Indian Standard

TEXTILE DYESTUFFS – IDENTIFICATION OF APPLICATION CLASSES OF DYESTUFFS IN SUBSTANCE

1 SCOPE

This standard prescribes methods of identification of application classes and chemical classes of dyestuffs in substance. These methods are mainly applicable to identification of a single class of dyestuffs and not to mixtures of two or more dyestuffs of different application classes.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 PREPARATION OF TEST SAMPLE

3.1 Sample from the lot shall be drawn so as to be representative of the lot. The sample drawn in accordance with the relevant material specification or as agreed to between the buyer and the seller shall be held to be representative of the lot. In case the material specification does not exist and there is no agreement between the buyer and the seller, a representative sample of the dyestuff shall be drawn as prescribed in **9.1** and **9.2** of IS 11635 : 1986.

3.2 If the dyestuff is in powder form, draw from each container selected small increments of the dyestuff by a suitable sampling instrument from at least three different parts and mix them thoroughly to get a composite test sample weighing about 20 g.

3.3 If the dyestuff is in liquid or paste form, stir the contents of each container selected thoroughly with a glass rod and draw small increments with a suitable sampling instrument from at least three different parts and mix them thoroughly to get a composite test sample weighing about 20 g.

4 APPARATUS, MATERIALS AND REAGENTS

4.1 Apparatus

4.1.1 *Test Tubes*

4.1.2 *Glass Beakers of 250 ml Capacity*

4.1.3 *Separating Funnels*

4.1.4 *Microscope*

4.1.5 *Porcelain Crucible*

4.2 Materials

4.2.1 *Lead Acetate Paper*

4.2.2 *Mordanted Wool*

4.2.3 *Scoured Acetate Fabric*

4.2.4 *Scoured Cotton Fabric*

4.2.5 *Scoured Wool Fabric*

4.2.6 *Burner*

4.2.7 *Hot Water Bath*

4.2.8 *Unmordanted Wool*

4.2.9 *Scoured Viscose Fabric*

4.3 Reagents

4.3.0 *Quality of Reagents*

Unless specified otherwise pure chemicals shall be employed in tests and distilled water (*see* IS 1070 : 1977) shall be used where the use of water as a reagent is intended.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the test results.

4.3.1 *Tannin Reagent*

Prepared by dissolving 10 g of tannin and 10 g of sodium acetate in 200 ml of water.

4.3.2 *Zinc Dust*

This must not have been kept too long.

4.3.3 *Acid Stannous Chloride Solution*

Prepared by dissolving 100 g of stannous chloride in 100 ml of pure concentrated hydrochloric acid and 50 ml of water.

4.3.4 *Lead Acetate Solution*

5 percent (*m/m*) solution in water.

4.3.5 *Acid Permanganate Solution*

Prepared by dissolving 1 g of potassium permanganate and 2 g concentrated sulphuric acid in 100 ml of water.

4.3.6 *Chromium Fluoride Reagent*

Prepared by dissolving 10 g of chromium fluoride and 5 g of sodium acetate in 100 ml of water.

4.3.7 *Alcohol (95 percent v/v)*

Ordinary strong alcohol or methylated spirit.

4.3.8 *Caustic Soda Solution (5 Percent)*

5 g caustic soda flakes dissolved in 100 ml of water.

4.3.9 *Caustic Soda (1 Percent)*

Dilute solution in **4.3.8** five times.

4.3.10 *Acetic Acid*

10 ml of glacial acetic acid dissolved in 95 ml of water.

4.3.11 *Dilute Formic Acid (1:100)*

1 ml of 90 percent formic acid in 100 ml of water.

4.3.12 *Dilute Hydrochloric Acid*

5 ml of concentrated hydrochloric acid in 100 ml of water.

4.3.13 *Dilute Ammonia (1:100)*

1 ml concentrated ammonia diluted with 100 ml of water.

4.3.14 *Aqueous Alcoholic Ammonia*

1 ml of concentrated ammonia mixed with 50 ml of water and 50 ml of alcohol.

4.3.15 *Concentrated Sulphuric Acid*

4.3.16 *Manganese Dioxide*

4.3.17 *Formosul G*

4.3.18 *Sodium Hypochlorite Solution*

Containing 2 g/l available chlorine.

4.3.19 *Pyridine-Water Mixture*

In the ratio of 57 : 43.

4.3.20 *Ethylene Diamine*

Sp gr 0·97, b. p. 117°C.

4.3.21 *Carbazol Solution*

1 percent in concentrated sulphuric acid.

4.3.22 *Iodine Solution* — 2·648 g/l.

4.3.23 *Silicotungstic Acid* ($SiO_2.12\,WO_3.\,20H_2O$)

4.3.24 *Ceric Sulphate Solution*

4.3.25 *Ferric Chloride Solution*

1 percent (*m/v*).

4.3.26 *Sodium Sulphide Solution*

5 percent (*m/v*).

4.3.27 *Methyl Pyrrolidene*

b. p. 202°C.

4.3.28 *Sodium Chloride*

4.3.29 *Potassium Persulphate Solution*

4.3.30 *Sodium Bicarbonate*

5 CLASSIFICATION OF DYESTUFFS

5.1 For the purpose of identification, the dyestuffs shall be classified into two main groups, namely, (a) water soluble dyestuffs and (b) water insoluble dyestuffs.

5.1.1 Water soluble dyestuff shall be classified into the following sub-groups:

a) Basic and basic mordant dyestuffs;
b) Direct and water soluble sulphur dyestuffs;
c) Acid, acid mordant and metal complex dyestuffs;
d) Solubilized vat dyestuffs; and
e) Reactive dyestuffs.

5.1.2 Water insoluble dyestuffs shall be classified into the following sub-groups:

a) Sulphur, mordant, spirit soluble, and vat dyestuffs;
b) Disperse dyestuffs and pigments; and
c) Naphthols, fast colour bases and fast colour salts.

6 TEST PROCEDURE

6.1 Test for Homogeneity of Dyestuff

Test the homogeneity of the dyestuffs by the methods prescribed in Appendix A of IS 4394 : 1988.

6.2 Identification of Water Soluble Dyestuffs

6.2.1 Add 10 percent acetic acid and tannin reagent to a 1·0 percent solution of the dyestuff. Formation of coloured precipitate indicates presence of basic and basic mordant dyestuffs. For further identification of these dyes, follow the procedure given in Table 1.

6.2.2 If no precipitate is formed, boil separately small volumes of dyestuff solution with white viscose rayon and with secondary acetate. Then boil the materials with 1·0 percent ammonia solution for 1 min. Viscose rayon dyed indicates presence of direct and water soluble sulphur dyestuffs. If neither fibre is dyed, it indicates presence of acid, acid mordant and metal complex dyestuffs. For further identification of these dyes follow the procedure given in Tables 2 and 3.

6.2.3 Add potassium persulphate solution to an acidified solution of the dyestuff and warm. Formation of coloured precipitate indicates the presence of solubilized vat dyestuffs.

6.2.4 If none of the dyestuffs as given in **6.2.1** to **6.2.3** are present, dye a piece of cotton cloth by padding in 1·0 percent dye solution containing sodium bicarbonate and dry at 105°C. Cotton dyed indicates the presence of reactive dyestuffs. For further identification of these dyestuffs, follow the procedure given in Annex B.

6.3 Identification of Water Insoluble Dyestuffs

6.3.1 For identification of sulphur, mordant, spirit soluble, sulphurized, indigoid and other vat dyestuff, follow the procedure given in Table 4.

6.3.2 For identification of disperse dyestuffs and pigments follow the procedure given in Table 5.

6.3.3 For identification of naphthols, fast colour bases and fast colour salts, follow the procedure given in Annex C.

6.4 Additional Tests

6.4.1 For further identification of certain of the above mentioned dyestuffs follow the procedure given in Annex D.

Table 1 Identification of Basic and Basic Mordant Dyestuffs

(*Clause* 6.2.1)

<table>
<tr><th colspan="11">Reduce 5 ml of hot solution (1.0 percent) of the dyestuff with zinc dust and a few drops of 5·0 percent acetic acid</th></tr>
<tr><td colspan="7">The solution is decolourized and the colour returns on exposure to air. The colour of the aqueous solution is</td><td rowspan="4">The solution is decolourised and a pink colour returns on exposure to <i>air—safarineazo class</i></td><td rowspan="4">The solution is decolourised and the colour returns on spotting with a glass rod dipped in acid permanganate solution on a filter paper dipped in decolourised solution—<i>Triphenyl methane</i> and <i>pyron classes</i></td><td rowspan="4">The solution is decolourised and the colour does not return either in air or with acid permanganate <i>azo class</i></td><td rowspan="4">Colour not altered—<i>Thiazoles and kewaimide classes</i></td></tr>
<tr><td>Red—<i>Azine Class</i></td><td>Orange and Yellow—<i>Acridine Class</i></td><td>Green—<i>Thiazine Class</i></td><td colspan="2">Blue—<i>Oxazine or Thiazine Class</i></td><td colspan="2">Violet—<i>Oxazine or Azine Class</i></td></tr>
<tr><td></td><td></td><td></td><td colspan="2">Add chromium fluoride reagent to 5 ml solution of the dyestuff</td><td colspan="2">Add chromium fluoride reagent to 5 ml solution of the dyestuff</td></tr>
<tr><td></td><td></td><td></td><td>Colour precipitated—<i>Basic mordant Dyestuff</i></td><td>No precipitate—<i>Basic Dyestuff</i></td><td>Colour precipitated—<i>Basic Mordant Dyestuff</i></td><td>No precipitate—<i>Basic Dyestuff</i></td></tr>
</table>

Table 2 Identification of Direct and Water Soluble Sulphur Dyestuffs

(*Clause* 6.2.2)

<table>
<tr><th colspan="4">Boil 5 ml of 1·0 percent dye solution in 5 ml acid stannous chloride in a test tube, the mouth of which is covered with filter paper moistened with lead acetate solution</th></tr>
<tr><td rowspan="2">A deep brown stain is produced*—<i>Sulphur class</i>
Add hydrochloric acid and zinc dust to the dye solution - H_2S evolution indicates—<i>Solubilized Sulphur dyestuff</i></td><td colspan="3">Little or no brown stain is produced — Direct dyestuff. Reduce with zinc dust and acetic acid</td></tr>
<tr><td>Colour reduces very slowly and incompletely—<i>Thiazol class</i></td><td>Decolourised. Colour returns in air—<i>Stilbene class</i></td><td>Decolourised. Colour does not return in air—<i>Azo class</i></td></tr>
</table>

*Prolonged boiling may discolour the brown stain due to the action of hydrochloric acid formed.

Table 3 Identification of Acid, Acid Mordant and Metal Complex Dyestuffs

(*Clause* 6.2.2)

Test the dye for presence of Cr, Co, Ni, Cu and Fe. Presence of metals indicates metalcomplex dyestuffs. If metals are absent, reduce the dyestuff with zinc dust and acetic acid

Colour unaltered—*Quinoline class*	Decolourised. Colour returns in air—*Azine, thiazone and pyron classes*	Decolourized. Colour returns on spotting with acid permanganate—*Triphenylmethane* and *pyron classes*	Decolourised. Colour does not return either in air or with acid permanganate — *Azo, nitro* and *nitroso* classes. Boil small pieces of chromed and unchromed wool together in the same dye solution for 30 min with a few drops of formic acid (1 : 100)	Not decolourised but *changed* in shade—*Anthracene class*

Chromed wool dyed more deeply and/or gives a faster colour than that obtained on the unchromed wool—*Acid Mordant dyestuff*	Little difference in colour between chromed and unchromed or wool dyed more deeply and/or gives a brighter dyeing than that obtained on the chromed wool — *Acid dyestuff*

Wash the dyed chromed and unchromed wool patterns thoroughly and boil with ammonia* (1 : 100)

Little or no colour stripped from the chromed pattern—*Acid Mordant dyestuff*	Colour stripped from both the patterns—*Acid dyestuff*

*In case of black dyes, aqueous alcoholic ammonia should be used instead of aqueous ammonia.

Table 4 Identification of Sulphur, Mordant, Spirit Soluble and Vat Dyestuffs

(*Clause* 6.3.1)

Add 0·1 g of dyestuff to 5·0 percent sodium hydroxide solution and warm							
The dyestuff dissolves. Add a little zinc dust and ammonia to the alkaline solution and boil	The dyestuff is insoluble in sodium hydroxide Boil with 95 percent alcohol						
	The dyestuff dissolves. Reduce the alcoholic solution with zinc dust and acetic acid				The dyestuff does not dissolve. Apply stannous chloride and lead acetate test		
Solution decolourised or changed in shade to yellowish brown or brown. On pouring on to filter paper, original colour returns. Apply stannous chloride and lead acetate test Brown stain produced—*Sulphur class*. Treat with cold dilute sodium hypochlorite solution for 5-10 min-decolourised —*sulphur dyestuff*	Solution decolourised on pouring on to filter paper-original colour does not return — *Mordant dyestuff* of the *nitroso* and *azo class*. Apply stannous chloride and lead acetate test. No stain produced—*Mordant dyestuff* of the *Anthracene, pyrene or examine class*	Remains unchanged *quinoline class*	Decolourized but colour returns in air or on spotting with acid permanganate — *Azine and triphenyl methane class*	Permanently decolourised —*Nitre and azo class*	Brown stain produced—*sulphurized vat dyestuff* Add 1:1 hydrochloric acid and zinc metal to the dyestuff — H_2S evolved and the dye is insoluble in sodium sulphide solution—*sulphurized vat dyestuff*. Add benzene to dyestuff not disssolved —*Sulpnurized vat dyestuff*	No brown stain produced. Reduce with sodium hydroxide (5 percent) and sodium hydrosulphite. The dyestuff dissolves and dyes viscose rayon—*Vat dyestuff*	
						The leuco compound is dark coloured—*Anthrocane and naphthacene classes*, Heat a little quantity of dye on watch-glass —does not sublime—*naphthacene classes*	The leuco compound is yellow or clear orange —*Indigoid class*. Heat a little dyestuff on watch glass sublimes and gives coloured vapours — *indigoid class*

Table 5 Identification of Disperse Dyestuffs and Pigments

(*Clause* 6.3.2)

Treat a piece of secondary cellulose acetate in a suspension of the dyestuff or pigment in 1 g/l soap solution at 80°C for 15 *Min*				
Secondary cellulose acetate dyed—*Disperse dyestuff*	Secondory cellulose acetate not dyed. Add 5 percent sodium hydroxide solution and 25 to 50 mg of sodium hydrosulphite and boil			
	Colour is dark violet. Add to it 20 percent acetic acid solution		Colour does not reduce. Treat the pigment with conc. nitric acid. Colour changes to violet and on treatment with conc. sulphuric acid the colour changes to bright green—*Phthalogen blue*	Colour is brown which changes to black when exposed to air-*Aniline black*. Warm the pigment in conc. sulphuric acid and pour a little cold water - Dull green colour confirms *Aniline black*. Treat the pigment in sodium hypochlorite solution for 1 min. Brown colour confirms *Aniline black*
	Colour remains violet—*Phthalogen green pigment*	Colour changes to green—*Alcian blue pigment*. Treat the pigment with conc. nitric acid and conc. sulphuric acid separately. Colour changes to green in each case — *Alcian blue pigment*		

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
1070 : 1977	Water for general laboratory use (*second revision*)
4394 : 1988	Method for evaluating strength of homogenous vat dyestuffs (*first revision*)
11635 : 1986	Method for determination of strength of disperse dyes for polyester by screen printing

ANNEX B

(*Clause* 6.2.4)

IDENTIFICATION OF REACTIVE DYESTUFF

B-1 Dye a piece of cotton fabric with 1·0 percent dye solution. Treat the dyeing in a solution of 1 ml/1 concentrated sulphuric acid and 2 g/1 sodium sulphate. The colour stripped from the cotton fabric indicates presence of dyes of *triazine type* (procions and cibacrons). In case no colour is stripped, it indicates presence of *vinyl sulphore type reactive dyes*.

B-2 Dye cotton piece with 1·0 percent dye solution at room temperature and at 60-70°C separately. If the cotton piece dyed at 60-70°C is more deeply dyed than the other, it indicates presence of *mono-chlorotriazinyl type reactive dye*. If the other piece is more deeply dyed, it indicates presence of *dichlorotriazinyl* reactive dye. Dye a piece of polyamide fabric with the dye. If the polyamide fibre is dyed, it indicates the presence of *procinyl dyes*.

B-3 Dye a piece of wool fabric at 80-90°C. Wool fabric dyed indicates presence of *lanasol dyes*.

B-4 Dye pieces of cotton and wool fabric with the dye. Wool fabric dyed more deeply indicates presence of *primazine type reactive dyes*.

B-5 Dye a piece of cotton fabric in 1·0 percent dye solution containing no alkali. Remove the piece and wash in water. If very little or no staining occurs, it indicates presence of *Levafix type reactive dyes*.

ANNEX C

(*Clause* 6.3.3)

IDENTIFICATION OF NAPHTHOLS, BASES AND FAST COLOUR SALTS

C-1 IDENTIFICATIONS OF NAPHTHOLS

C-1.1 Treat the dyestuff with a diazotised base. Formation of coloured compound indicates the presence of naphthols.

C-1.2 For the identification of a particular naphthol, crystallize the sample of the dye twice from a suitable organic solvent and determine its melting point and molecular weight.

C-2 IDENTIFICATION OF FAST COLOUR BASES

C-2.1 Prepare aqueous solution of the base. If it is acidic to litmus paper then the base is present as a salt. Then add excess caustic soda to the base and heat to boiling with vigorous stirring. Cool the mixture and if base separates out as a solid, filter and wash it free from alkali and crystallize it from water, alcohol or any other suitable solvent. If, on the other hand, the base separates out as a liquid, cool the mixture thoroughly and extract with other. Make the extract free from alkali by washing with water and treat with anhydrous sodium sulphate and then evaporate. Identify the free base thus separated by melting and boiling points of the free bases and their acetyl, benzeyl azo-*p*-naphthol derivatives.

C-3 IDENTIFICATION OF FAST COLOUR SALTS

C-3.1 Treat the substrate with alkaline naphthol solution. Formation of coloured compounds indicates the presence of *fast colour salts*. For further identification, couple the fast colour salt with *p*-naphthol. Crystallize the insoluble dye formed from a suitable solvent and determine its melting point.

ANNEX D

(*Clause* 6.4.1)

ADDITIONAL TESTS

D-1 BASIC DYES

D-1.1 Acidify 1 percent solution of the dye with 10 percent acetic acid. Add to it 1 percent solution of ferric chloride, a black precipitate is obtained.

D-1.2 To a 1 g/l solution of dye, add 2·648 g/l solution of iodine. Spot the turbid liquid on a plate having a spot of starch so that both merge together. The starch turns blue.

D-1.3 Add silicotungstic acid ($SiO_2 . 12 WO_3 . 20 H_2O$) to 1 g/l dye solution and add a little hydrochloric acid. A precipitate is obtained which is insoluble in cold and boiling water and boiling dilute hydrochloric acid.

D-2 SULPHUR DYES

D-2.1 Boil 0·1 g dye with ethylene diamine. The dye gets dissolved giving coloured solution.

NOTE — Indocarbon black dyes give reddish solution which revert to original shade on dilution with water whereas sulphur black gives greenish solution.

D-3 SOLUBILIZED VAT DYES

D-3.1 Dissolve about 0·5 g of dye in 50 ml water. Add slowly with constant stirring a mixture of 50 ml water, 5-10 ml (or more if necessary) ceric sulphate solution and 10 ml concentrated sulphuric acid and keep in hot water bath at about 80°C for 3 to 5 min. The parent regenerated vat dye will be precipitated.

D-4 DIRECT DYES

D-4.1 Introduce few pieces of white cotton in 1 percent dye solution and heat to 80°C. Add little sodium chloride and allow it to cool. The white cotton is stained evenly and the stain is not removed by boiling with 1 percent ammonium hydroxide solution.

D-5 ASH TEST

D-5.1 Add 0·2 to 0·3 g of flux composed of equal parts by mass of powdered sodium carbonate and sodium nitrate to 0·1 g of dye. Fuse the mixture and allow it to cool. The presence of any metal is indicated by the colour of the fused mass as follows:

Colour of Fused Mass	*Metal Present*
Yellow	Cr
Royal blue	Co
Blue-green	Mn

The presence of Co or Mn indicates Neutral Dyeing (1 : 2 metal complex dyes). The presence of Cr indicates chrome dyes or metallized dye (that is 1 : 1 metal complex and 1 : 2 metal complex dyes).

D-6 REACTIVE DISPERSE (PROCINYL) DYES

D-6.1 To 0·1 percent dye solution in formic acid or chlorophenol, add 1 ml of ethylene diamine hydrate diluted with 5 to 10 ml of water. Warm for 5 to 10 minutes and then filter. If the dye remains along the precipitate, it is a reactive disperse dye.

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Bureau of Indian Standard

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writting of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designation. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Revision of Indian Standards

Indian Standards are reviewed periodically and revised, when necessary and amendments, if any, are issued from time to time. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition. Comments on this Indian Standard may be sent to BIS giving the following reference:

Doc : No. TXD 17 (2485)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75
Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices : Telephone

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg
NEW DELHI 110002 — 331 01 31, 331 13 75

Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola
CALCUTTA 700054 — 37 84 99, 37 85 61, 37 86 26, 37 85 62

Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036 — 53 38 43, 53 16 40, 53 23 84

Southern : C. I. T. Campus, IV Cross Road, MADRAS 600113 — 41 24 42, 41 25 19, 41 23 15, 41 29 16,

Western : Manakalaya, E9 MIDC, Marol, Andheri (East)
BOMBAY 400093 — 632 92 95, 63 27 80, 632 78 92

Branches : AHMADABAD, BANGALORE, BHOPAL, BHUBANESHWAR, COIMBATORE FARIDABAD, GHAZIABAD, GUWAHATI, HYDERABAD, JAIPUR, KANPUR, LUCKNOW, PATNA, THIRUVANANTHAPURAM.

Printed at Printwell Printers, Aligarh, India